Superconducting Materials R&D

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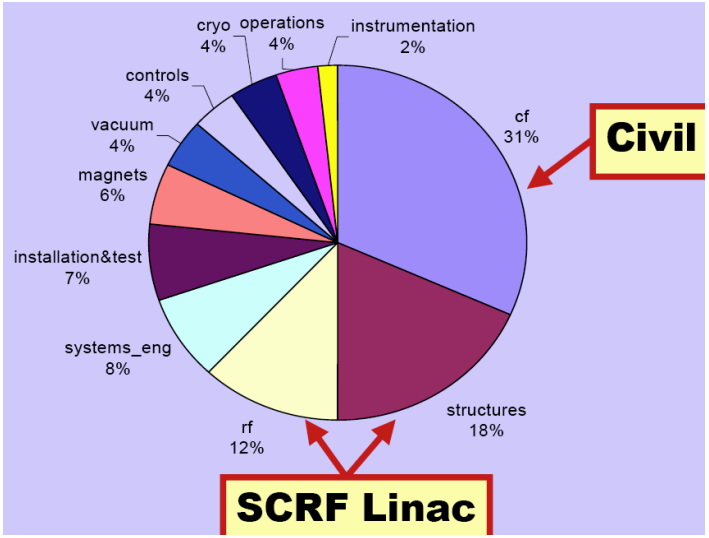

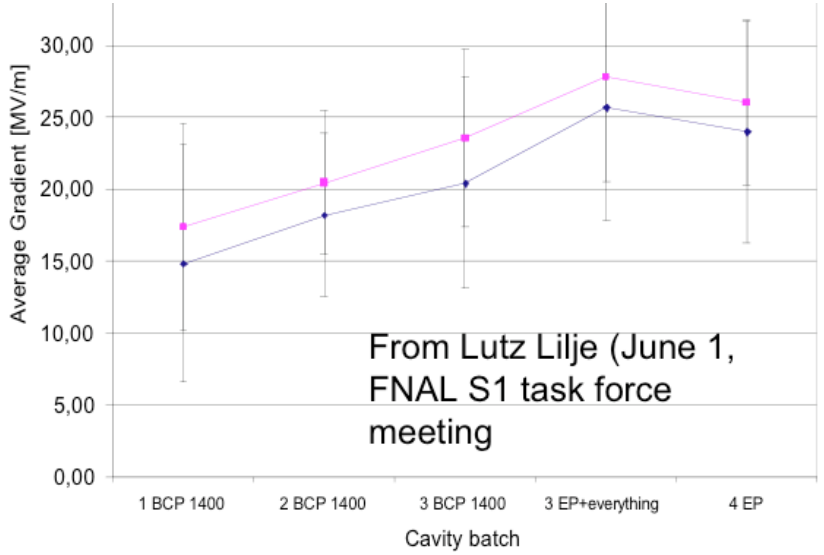

- The high gradient limits of linacs should be the main line of Accelerator R&D.
  Vital for energy frontier machines: ILC, Muon Collider/Neutrino Source, CLIC
  . . and Argonne projects: ERL, RIA', IPN$_{cold}$S

- Historically this effort has been dominated by an engineering approach.

- My own efforts are aimed at the physics/materials science
  Model of limits in warm cavities (some application to SCRF)
  Development of APT for niobium surfaces (paper at SRF2005)
  Encouraging GCIB smoothing tests for SCRF (Insepov, Epion)

Fermilab started a materials effort.

- The Midwest SCRF Materials Collaboration, started by Pierre Bauer (Fermilab)

  Now led by Claire Antoine (FNAL)

  Initially local universities: MSU, U. Wisconsin

  Two meetings a year

- Getting ANL materials/surface science into the Fermilab local collaboration:
  C. Cooper & C. Antoine visit to MSD, Nanotech., & Elect. Micro. , last May.

- Workshop on SRF Materials Nov 14.
  Some skepticism from FNAL management
  Argonne speakers arranged by J-P Allain (MCT)
  About 30 people came (ANL + Outsiders)

Agenda for Midwest SCRF Materials Meeting:
Held At Argonne on November 14th

8:30 - 8:40	A. Sattelberger "Welcome to Argonne"
8:40 - 9:05	Claire Antoine (Fermi) "20 Years of Developments in SCRF Nb"
9:05 – 9:20	Peter Lee "Summary of Recent Microstructural, Microchemical and Magneto Optical Investigations."
9:20 – 9:35	Alex Gurevich "Enhancement of RF Breakdown Field by Multilayer Coating: A Possibility to Break the Nb Monopoly in SRF cavities."
9:35 – 9:50	James Norem "Pulsed Power Processing and Gradient Limits in Normal RF Structures"
9:50 – 10:05	Z. Insepov "Can Gas Cluster Ion Beam Processing Tell Us about High Field Q Slope?"
10:45 – 11:10	J-P. Allain "Particle-Surface Interaction Experiments in the PRIME Facility"
11:10 – 11:30	Paul Zschack "Surface characterization techniques at the APS"
11:30 – 11:45	Mike Pellin "Atomic Layer Deposition processes and surface-sensitive characterization techniques"
1:00 – 1:15	Hairong Jiang "Mechanical Properties of Niobium"
1:15 – 1:30	Derek Baars "Properties of Recrystalization and Niobium"
1:30 – 1:45	Chris Compton/Steve Bricker "Recent Developments of High Purity Niobium TIG Welding"
1:45 – 2:00	Ahmad Aizaz "Heat Transfer in Niobium"
2:00 – 2:15	Charlie Cooper "Effects of Cutting Techniques on Surface Properties of Nb"
2:15 – 2:30	Kevin Eylhan Yoon, David N. Seidman (NWU) "Recent Results from 3D Atomic Probe on Niobium"

Results of the Workshop

Result #1

- Experiment to study Atomic Layer Deposition
  Pellin, Elam, Antoine, Seidman, Norem + . .

- Failure modes of SCRF . . . . . can be cured by this technique
  Field Emission: Coatings increase radii of asperities, lowering local field
  H_{c1}: Multiple coatings can shield niobium (A. Gurevich)
  High field Q slope: Pure coating on good substrate eliminates most causes

- Phase I: study small samples, Phase II: coat and test cavity

Result #2

- General proposal for SRF materials R&D was outlined.

- Interested parties: FNAL, ANL, U of Wisc, Northwestern U, IIT, U of Chicago,
  Michigan State, Fl State/NHMFL

- Claire Antoine (FNAL) is collecting contributions.

Result #3

- Better cooperation and communication.

  On Monday Jan 15th a Fermilab Seminar was held at Argonne, on the subject of oxygen diffusion in niobium, to an audience from Fermilab, Northwestern, IIT, the University of Chicago, ANL/APS, ANL/MSD.

Result #4

- The most immediate diagnostic interest is with J-P Allain's PRIME facility, a general purpose surface analysis system.

Result #5

- Argonne is considered part of the SCRF community, could perhaps lead it.